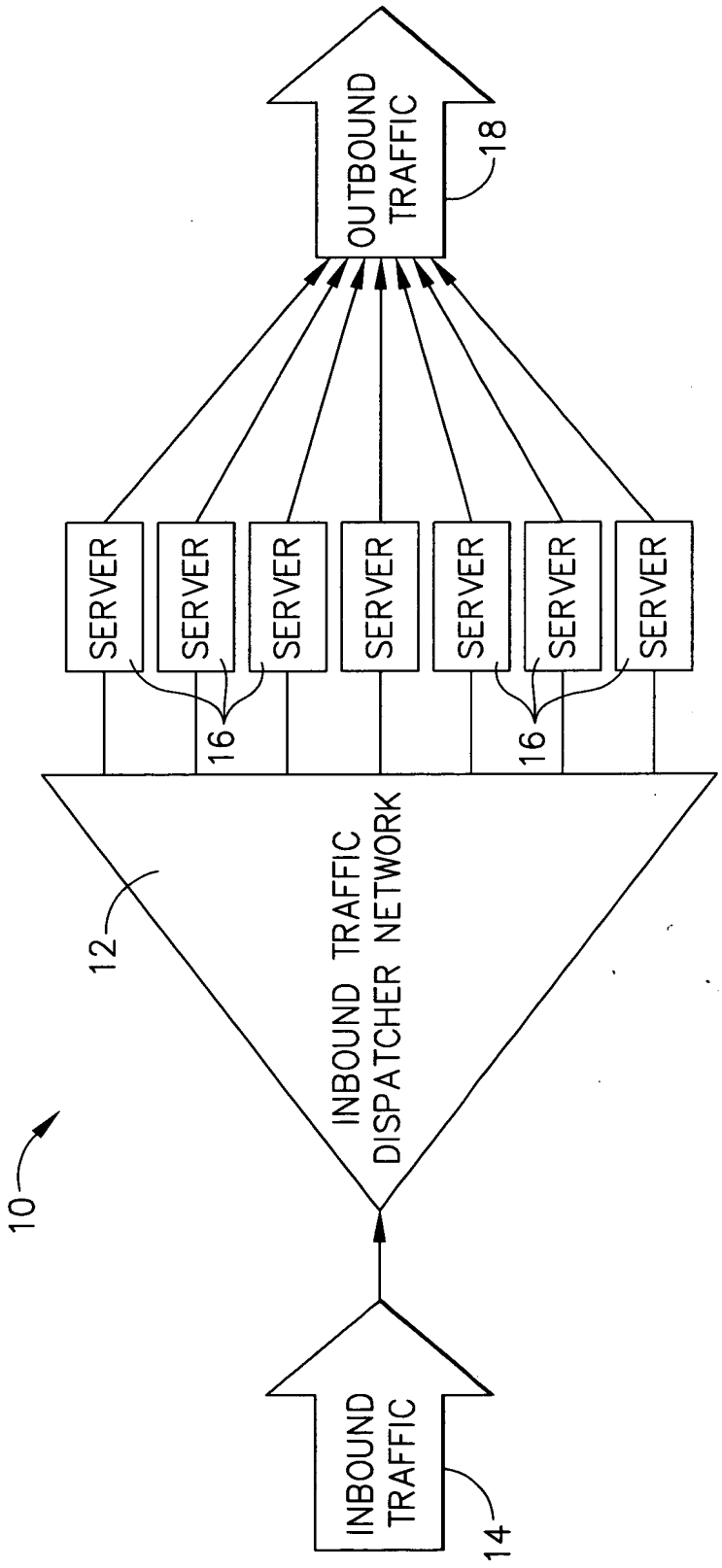
OUTBOUND TRAFFIC
18
SERVER
SERVER
SERVER
SERVER
SERVER
SERVER
SERVER
16
16
INBOUND TRAFFIC DISPATCHER NETWORK
12
10
INBOUND TRAFFIC
14

FIG. 1

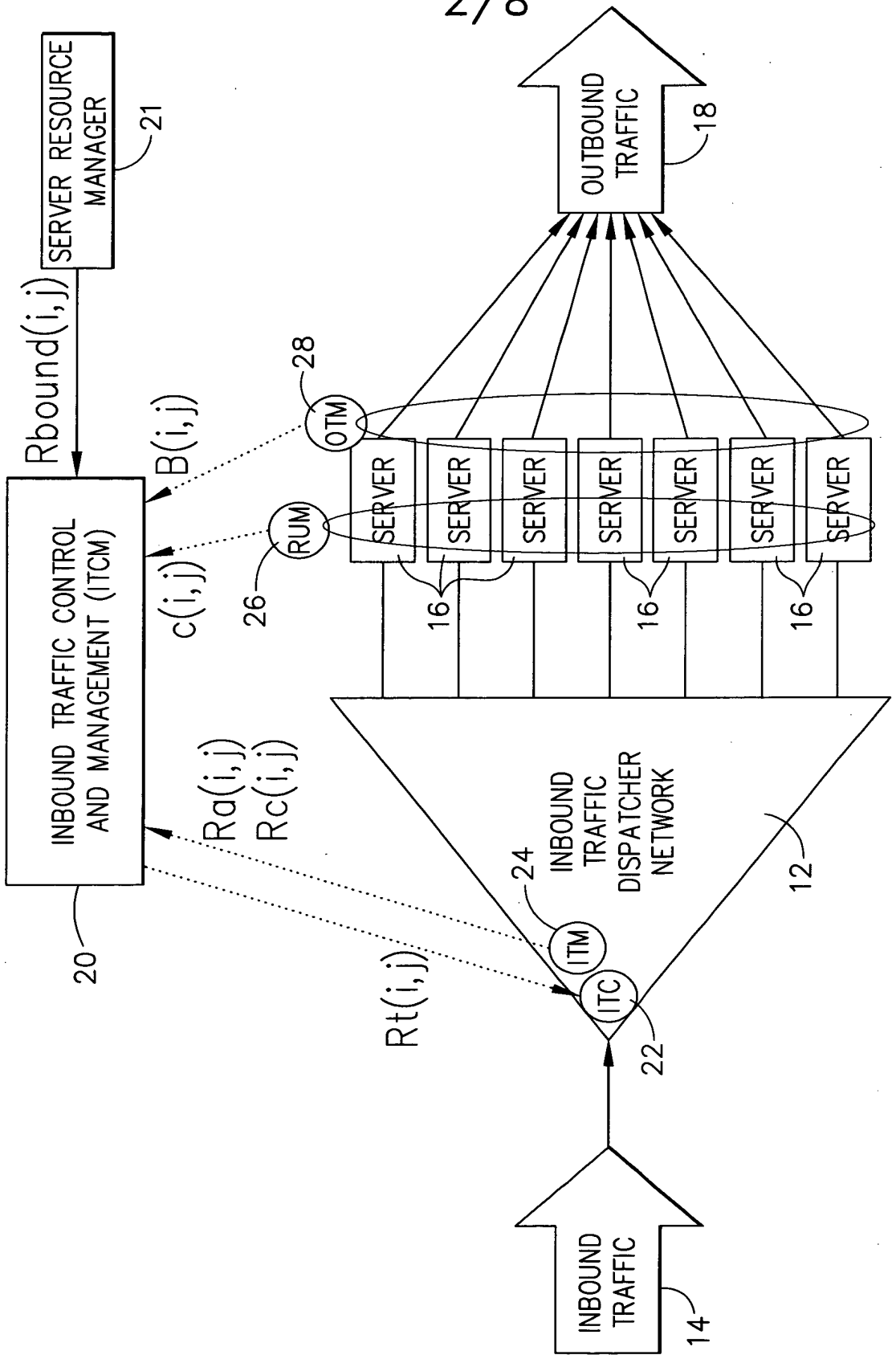
SERVER RESOURCE MANAGER
21
Rbound(i,j)
INBOUND TRAFFIC CONTROL AND MANAGEMENT (ITCM)
20
B(i,j)
c(i,j)
Ra(i,j)
Rc(i,j)
Rt(i,j)
28
OTM
26
RUM
24
ITM
ITC
22
SERVER
16
INBOUND TRAFFIC DISPATCHER NETWORK
12
OUTBOUND TRAFFIC
18
INBOUND TRAFFIC
14

FIG. 2

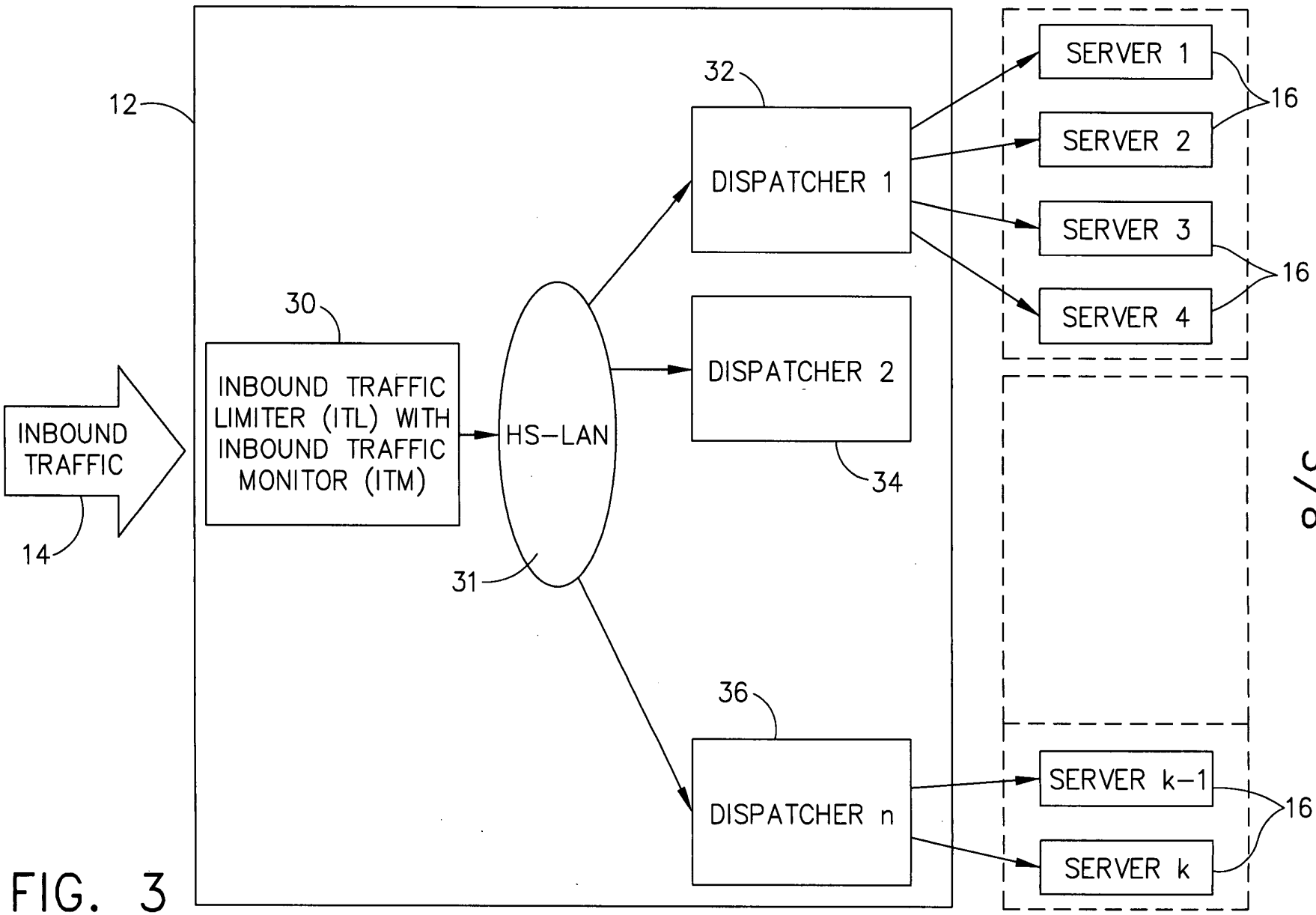
12
INBOUND TRAFFIC
14
30
INBOUND TRAFFIC LIMITER (ITL) WITH INBOUND TRAFFIC MONITOR (ITM)
HS-LAN
31
32
DISPATCHER 1
DISPATCHER 2
34
36
DISPATCHER n
SERVER 1
SERVER 2
SERVER 3
SERVER 4
16
16
SERVER k-1
SERVER k
16

FIG. 3

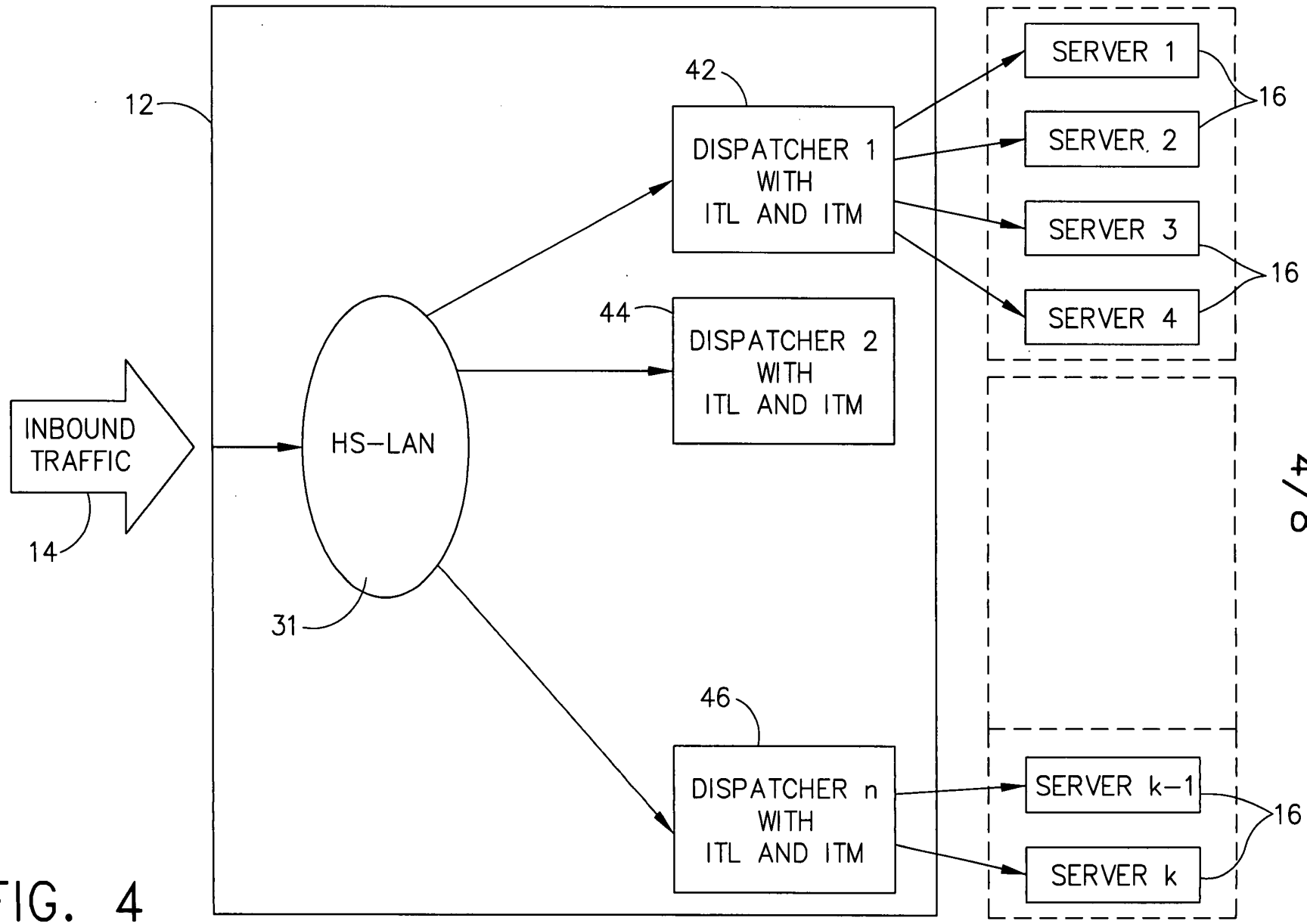
12
42
DISPATCHER 1
WITH
ITL AND ITM
SERVER 1
SERVER 2
SERVER 3
SERVER 4
16
16
44
DISPATCHER 2
WITH
ITL AND ITM
INBOUND
TRAFFIC
14
HS-LAN
31
46
DISPATCHER n
WITH
ITL AND ITM
SERVER k-1
SERVER k
16

FIG. 4

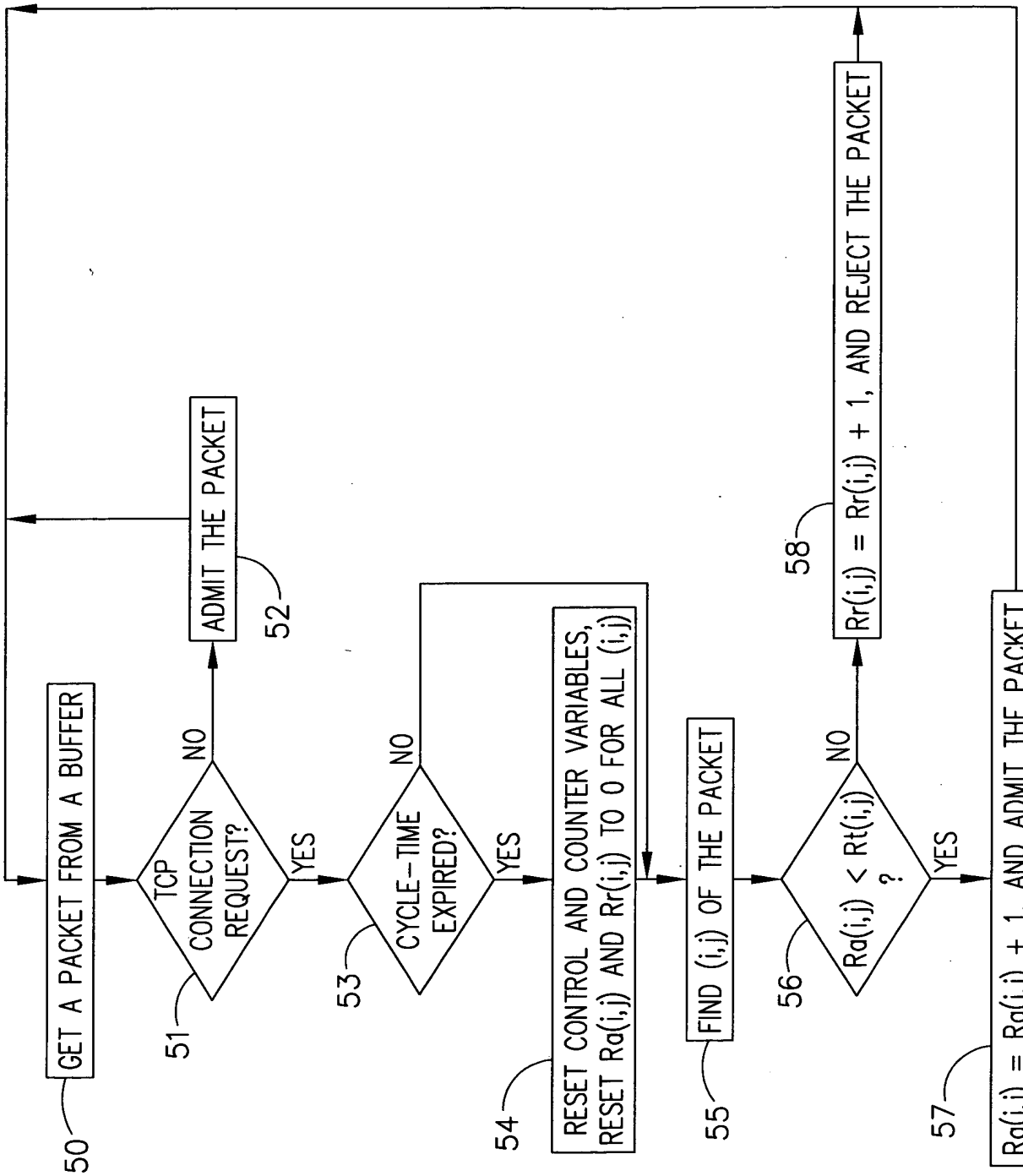
GET A PACKET FROM A BUFFER
50
TCP CONNECTION REQUEST?
51
NO
YES
ADMIT THE PACKET
52
CYCLE-TIME EXPIRED?
53
NO
YES
RESET CONTROL AND COUNTER VARIABLES, RESET Ra(i,j) AND Rr(i,j) TO 0 FOR ALL (i,j)
54
FIND (i,j) OF THE PACKET
55
Ra(i,j) < Rt(i,j) ?
56
NO
YES
Rr(i,j) = Rr(i,j) + 1, AND REJECT THE PACKET
58
Ra(i,j) = Ra(i,j) + 1, AND ADMIT THE PACKET
57

FIG. 5

STEP 1

61

```
START:
FOR ALL (i,j), SET Bmax(i,j) = MIN (Bmax(i,j),
        Rbound(i,j)*b(i,j);
FOR ALL (i,j), SET Bt(i,j) = b(i,j)*Ra(i,j);
LET Bt BE THE SUM OF Bt(i,j) OVER ALL (i,j);
IF Bt>Btotal THEN GO TO STEP 2;
IF ((Rr(i,j)=0
     & Bt(i,j)<Bmax(i,j))) OVER ALL (i,j)
     THEN GO TO STEP 5;  ELSE GO TO STEP 2;
```

```
/* REFLECTING "EXTERNAL CONSTRAINT" Bbound(i,j) */
/* ESTIMATING THE CURRENT OUTBOUND TRAFFIC */
/* ESTIMATING THE CURRENT TOTAL
                    OUTBOUND TRAFFIC */
/* LINK CONJECTION DETECTED */
/* NO REQUEST REJECTION */
/* SLA IS NOT VIOLATED."<="
          MEANS LESS-THAN-OR-EQUAL-TO */
```

STEP 2

62

```
COMPUTE_BANDWIDTH_TARGETS:
FOR ALL (i,j), SET Bt(i,j) =b(i,j)*Ra(i,j)+Rr(i,j);
LET Bt BE THE SUM OF Bt(i,j) FOR ALL (i,j);
FOR EVERY (i,j) SUCH THAT Bt(i,j)>Bmax(i,j)
     FIRST SET Bt = Bt-Bt(Bt(i,j)-Bmax(i,j))
     AND THEN SET Bt(i,j) =Bmax(i,j);
IF Bt <= Btotal
     THEN GO TO STEP1; ELSE GO TO STEP 3;
```

```
/* COMPUTING NEW TARGETS FOR BANDWIDTH USAGE */
/* ESTIMATING OUTBOUND TRAFFIC WHEN ALL REQUESTS
                ARE ADMITTED */
/* THIS STEP IS NEEDED SINCE Bt(i,j) WERE JUST
                RE-COMPUTED */
/* WANTS TO GENERATE MORE THAN THE MAXIMUM SLA */
/* ADJUST EXPECTED TOTAL OUTBOUND TRAFFIC */
/* BOUNDING TRAFFIC BY MAXIMUM SLA */
/* NO LINK CONGESTION WILL BE ANTICIPATED */
```

FIG. 6A

STEP 3

63

```
LET Bexcess BE THE SUM OF (Bt(i,j)-Bmin(i,j) OVER THOSE Bt(i,j)>Bmin(i,j);
                                        /* COMPUTING "EXCESS" BANDWIDTH */
/* PERFORM EITHER CASE 1 OR CASE 2 */
/* CASE 1: COMPUTE "SHARABLE" BANDWIDTH WHEN BANDWIDTH BORROWING IS PERMITTED */
LET Bsharable BE Btotal MINUS THE SUM OF SMALLER OF (Bt(i,j) AND Bmin(i,j)) OVER ALL (i,j);
/* CASE 2: COMPUTE "SHARABLE" BANDWIDTH WHEN BANDWIDTH BORROWING IS NOT PERMITTED */
LET Bsharable BE Btotal MINUS THE SUM OF Bmin(i,j) OVER ALL (i,j);
FOR EVERY (i,j) SUCH THAT Bt(i,j)>Bmin(i,j)          /* PERFORM FAIR PRORATION */
   SET Bt(i,j) = Bmin(i,j) + (Bt(i,j) - Bmin(i,j)) * (Bsharable/Bexcess);
```

STEP 4

64

```
COMPUTE_NEW_RATES:
FOR EVERY (i,j) SUCH THAT Bt(i,j)<=Bmin(i,j)     /* THIS IS EQUIVALENT TO "NO THROTTLING" */
                  SET Bt(i,j) = Bmax(i,j);       /* COMPUTING TARGET RATES */
FOR EVERY (i,j) SET Rt(i,j) = Bt(i,j)/b(i,j);    /* OPTIONAL COMPUTATION, RATE FOR EACH SERVER */
OPTIONALLY COMPUTE Rt(i,j,k) FROM Rt(i,j)
                   FOR ALL k;
```

STEP 5

65

```
STOP:
```

FIG. 6B

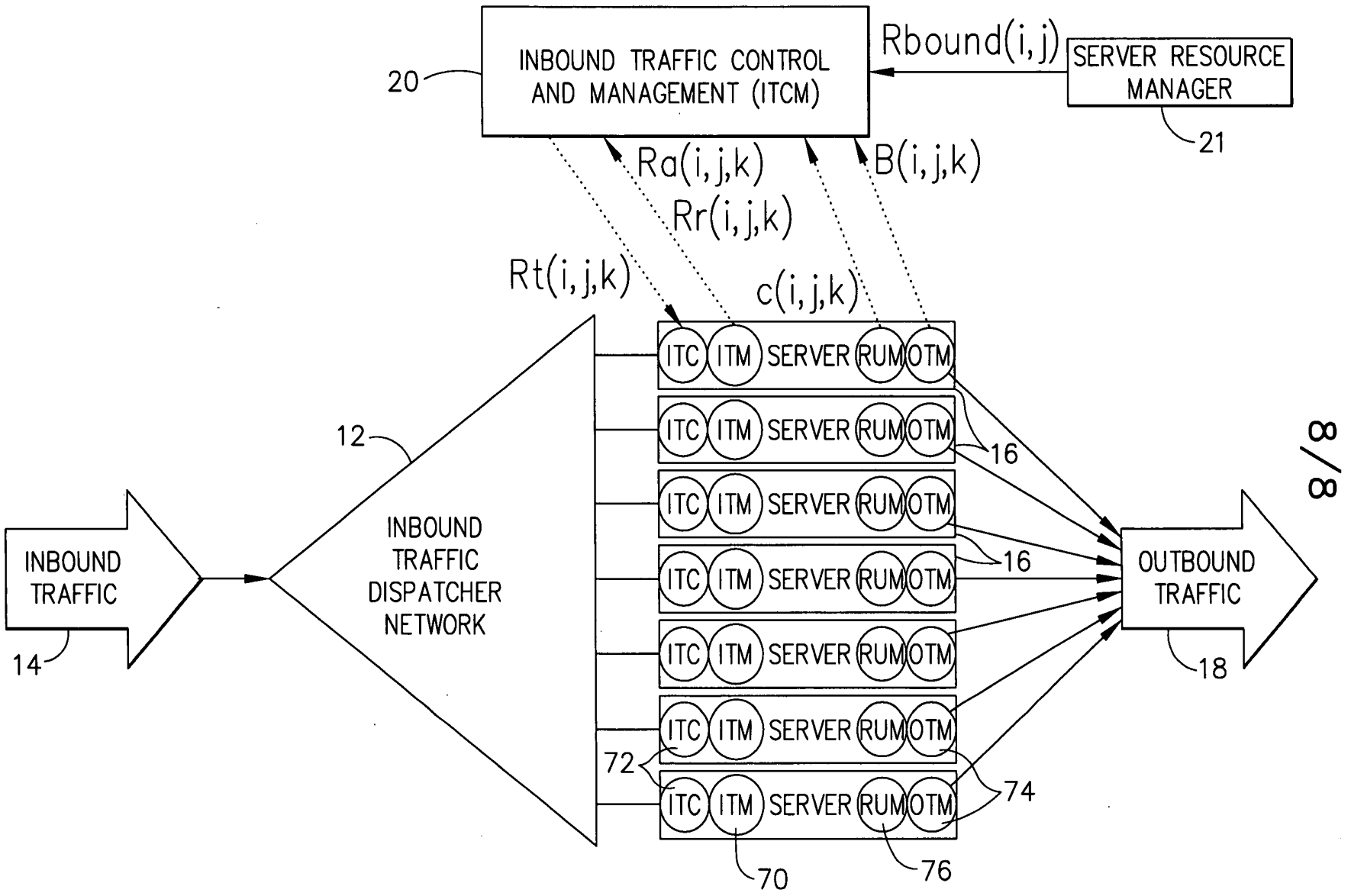
INBOUND TRAFFIC CONTROL AND MANAGEMENT (ITCM)
20
Rbound(i,j)
SERVER RESOURCE MANAGER
21
Ra(i,j,k)
Rr(i,j,k)
Rt(i,j,k)
B(i,j,k)
c(i,j,k)
ITC
ITM
SERVER
RUM
OTM
12
INBOUND TRAFFIC DISPATCHER NETWORK
INBOUND TRAFFIC
14
16
OUTBOUND TRAFFIC
18
72
74
70
76

FIG. 7